Fermilab

TM-860B
1670.000

CCI Report No. 390-104

MAGNET TEST FACILITY

MAGNET PROTECTION, QUENCH CIRCUIT TIE-IN

Prepared Under Fermilab Subcontract No. 94199
By Cryogenic Consultants, Inc.
Allentown, Pa.

For

Fermi National Accelerator Laboratory, Batavia, Illinois

January 8, 1979

MAGNET TEST FACILITY

TM-860B
1670.000

MAGNET PROTECTION, QUENCH CIRCUIT TIE-IN

The quench circuit outlined in CCI Report #370-101 was designed to be used with a pilot-operated relief device. The pilot envisioned for use was to be a self-actuated safety device such as those used on Anderson-Greenwood relief valves. In addition, a trigger was also to be provided to allow for manual or automatic trip of the device (see Figure 1). Since this valve was to be the only relief device for the magnet, it should be a self-actuated device, reliant on no other system for its actuation. In addition, the valve cannot be in anyway isolatable from the system.

As designed, the quench circuit ejects liquid from the 1Ø region of the magnet through the lead box and relief valve into a large volume. The cold gas absorbs heat from the environment and is subsequently reinjected into the main process stream.

The system should be able to recover from a full quench in 6-10 minutes.

Due to cost prohibitions, the Anderson-Greenwood device has been eliminated from present thinking. In its place, various devices, including Ross valves and in-house designed units, are now being considered. The devices would be triggered, but are not safety valves in the true sense. In addition, they are typically put in series with a manual valve which will allow positive shut-off of the gas stream should the triggered device fail to reseat after opening.

An acceptable circuit for the magnet is shown in Figure 2. Relief valve 1 will vent to atmosphere, relief valve 2 will also vent to atmosphere. The Ross valve will vent to the quench tank where the gas will be recovered.

The settings of the relief devices 1 and 2 will vary, depending on pressure values determined during tests. Relief valve 1 can be set close to what the current reliefs are, assuming that back pressure through the Ross valve is not high enough to cause it to relieve.

If relief valve 1 is tied into the quench system, back pressure will cause the relief pressure to vary with back pressure. This is unacceptable from a safety standpoint.

The setting on relief valve 2 will be unknown until tests determine what value it rises to during a quench. During previous tests, magnet pressures rose to 90-100 psi during a quench, even with the Ross valve open.

If that is still the case with the Ross valve in the new position on the lead box, the use of a relief at this point is either useless or will defeat the purpose of the quench circuit. (Useless if it must be set above 90 psi; defeat the purpose of recovering the fluid if it vents during each quench.)

Magnet protection must be tamper-proof and not reliant on operator interaction. The use of a pilot-operated relief valve with the trigger, as shown in Figure 1, is still the simplest, most effective and safest alternative. I would recommend that that system be reevaluated.

SCHEMATIC REPRESENTATION
AGCO RELIEF VALVE (PILOT OPERATED)

PRESSURE P SUPPLIES SEATING FORCE FOR SEAT SEAL C BY APPLYING FORCE BY VIRTUE OF PISTON B. {PISTON B AREA IS > SEAD C. DIA}

IF PRESSURE P RISES ABOVE VALUE SET ON PILOT VALVE, PILOT OPENS VENTING VOLUME A, OPENING VALVE. SOLENOID TRIGGER MAY BE ACTUATED IN ADVANCE IF NEC. BUT NEVER DEFEATS PILOT ACTION.

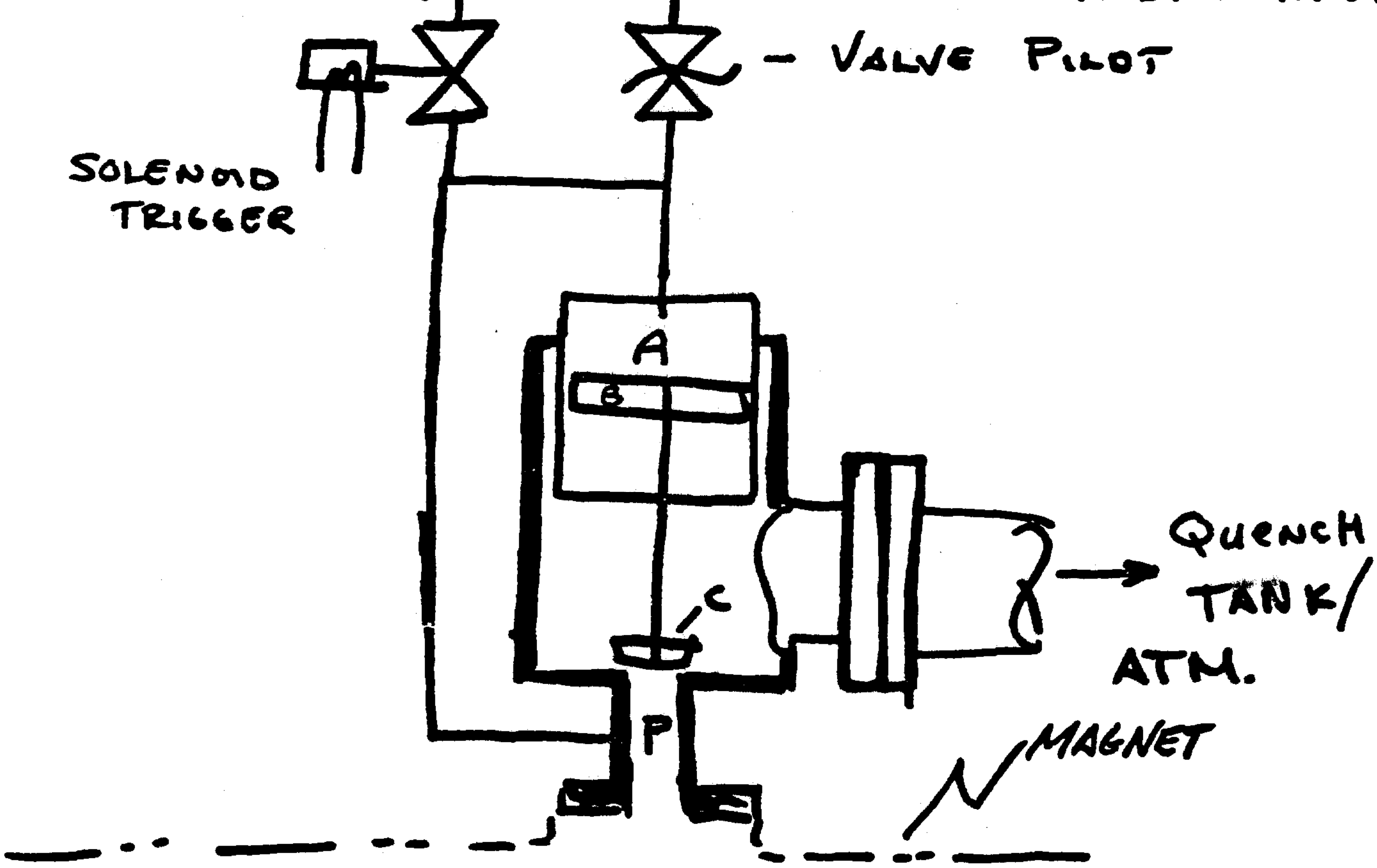

fig. 1

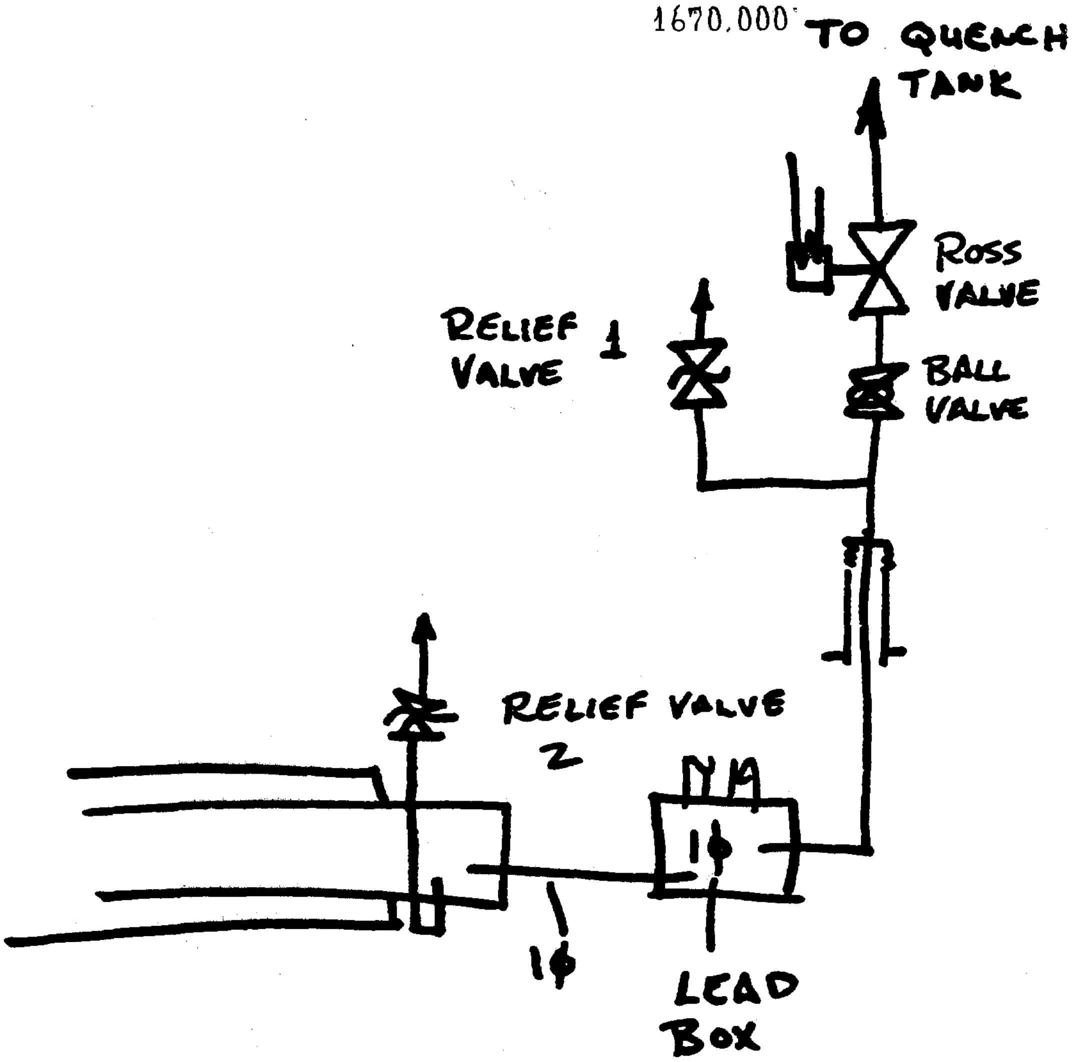
TO QUENCH TANK
ROSS VALVE
RELIEF VALVE 1
BALL VALVE
RELIEF VALVE 2
1ϕ
1ϕ
LEAD BOX

Fig 2